

Vent System Analysis for the Cryogenic Propellant Storage Transfer Ground Test Article

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To test and validate key capabilities and technologies required for future exploration elements such as large cryogenic propulsion stages and propellant depots, NASA is leading the efforts to develop and design the Cryogenic Propellant Storage and Transfer (CPST) Cryogenic Fluid Management (CFM) payload. The primary objectives of CPST payload are to demonstrate: 1) in-space storage of cryogenic propellants for long duration applications; and 2) in-space transfer of cryogenic propellants. The Ground Test Article (GTA) is a technology development version of the CPST payload. The GTA consists of flight-sized and flight-like storage and transfer tanks, liquid acquisition devices, transfer, and pressurization systems with all of the CPST functionality. The GTA is designed to perform integrated passive and active thermal storage and transfer performance testing with liquid hydrogen (LH₂) in a vacuum environment. The GTA storage tank is designed to store liquid hydrogen and the transfer tank is designed to be 5% of the storage tank volume. The LH₂ transfer subsystem is designed to transfer propellant from one tank to the other utilizing pressure or a pump. The LH₂ vent subsystem is designed to prevent over-pressurization of the storage and transfer tanks. An in-house general-purpose computer program was utilized to model and simulate the vent subsystem operation. The modeling, analysis, and the results will be presented in the final paper.